PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 16740-2PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/CA2004/002179	International filing date *(day/month/year)* 22 December 2004 (22-12-2004)	Priority date *(day/month/year)* 24 December 2003 (24-12-2003)

International Patent Classification (IPC) or national classification and IPC
IPC: ***C01B 31/02*** (2006.01) , ***C04B 41/50*** (2006.01) , ***C04B 35/52*** (2006.01) , ***B82B 3/00*** (2006.01)

Applicant
NANOMETRIX INC. ET AL

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of 6 sheets, as follows:
      [X] sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. 1 and the Supplemental Box.
   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - [X] Box No. I Basis of the report
   - [ ] Box No. II Priority
   - [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - [ ] Box No. IV Lack of unity of invention
   - [X] Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - [ ] Box No. VI Certain documents cited
   - [ ] Box No. VII Certain defects in the international application
   - [ ] Box No. VIII Certain observations on the international application

Date of submission of the demand 21 October 2005 (21-10-2005)	Date of completion of this report 27 March 2006 (27-03-2006)
Name and mailing address of the IPEA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476	Authorized officer Stewart Parsons (819) 953-2802

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/002179

Box No. I Basis of the report

1. With regard to the **language,** this report is based on:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into , which is the language of a translation furnished for the purposes of:

[ ] international search (Rules 12.3(a) and 23.1(b))

[ ] publication of the international application (Rule 12.4(a))

[ ] international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

[ ] the international application as originally filed/furnished

[ ] the description:

[X] pages 1-13 as originally filed/furnished

[ ] pages* received by this Authority on

[ ] pages* received by this Authority on

[ ] the claims:

[ ] pages as originally filed/furnished

[ ] pages* as amended (together with any statement) under Article 19

[X] pages* 14-19 received by this Authority on 03 February 2006 (03.02.2006)

[ ] pages* received by this Authority on

[ ] the drawings:

[X] pages 1-2 as originally filed/furnished

[ ] pages* received by this Authority on

[ ] pages* received by this Authority on

[ ] a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. [ ] The amendments have resulted in the cancellation of:

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/figs

[ ] the sequence listing *(specify):*

[ ] any table(s) related to sequence listing *(specify):*

4. [ ] This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/figs

[ ] the sequence listing *(specify):*

[ ] any table(s) related to sequence listing *(specify):*

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/002179

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-41	YES
	Claims		NO
Inventive step (IS)	Claims	1-41	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-41	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The following documents are referred to in the search report:
D1 (Dodelet et al.)
D2 (Dai et al.)
D3 (Smalley et al.)
D4 (Takahito et al.)
D5 (Li et al.)

The amended claims 1-41 submitted 03/02/2006 are judged to be novel and possess an inventive step as none of the cited prior art D1-D5 suggests the organization of the "nano-sized catalyst particles" in a "bi-dimensionally organized monolayer" upon the uniform substrate surface. Hence the requirements of Article 33(2) and 33(3) of the PCT are met.

The closest prior art is judged to be D5 (Li et al.) which teaches the production of aligned carbon nanotubes from a surface which contains iron nanoparticles imbedded in the bottom of cavities within the substrate surface. The amended claims distinguish over D5 as the nanotube growth surface of D5 is not uniform, consisting of cavities in which the catalytic nanoparticles are deposited, and by virtue of this deposition in cavities the nanoparticles are oriented in three dimensions, not in a bi-dimensionally organized monolayer. Hence the requirements of Article 33(2) and 33(3) of the PCT are met.

Claims 1-41 have industrial applicability being directed to methods of nanotube manufacture. Hence the requirements of Article 33(4) of the PCT are met.

CLAIMS:

1. A method of manufacturing a nanotube growing mat comprising:

   providing a substrate comprising a uniform supporting layer and carbon;

   applying nanosized catalytic particles in a bi-dimensionally organized monolayer on the uniform supporting layer in a predetermined pattern, the pattern promoting growth in an organized manner from the catalytic particles as a function of the pattern.

2. The method of claim 1, wherein the substrate is porous.

3. The method of claim 1, wherein the uniform supporting layer comprises a patterned monolayer of carbon nano- or micro-particles.

4. The method of claim 3, wherein the substrate comprises non-carbon elements selected from the group consisting of Si, N, and P, to produce a hetero-substrate.

5. The method of claim 4, wherein substrate and the hetero-substrate are placed in a multilayer configuration.

6. The method of claim 4, wherein the hetero-substrate contains Si which is incorporated into the nanotube produced on the mat and produces a hetero-nanotube with carbon and silicon.

7. The method of claim 5, wherein the multilayer configuration produces a complex nanotube comprising carbon and silicon in alternating layers.

8. The method of claim 1, wherein the catalytic particles are a metal.

9. The method of claim 8, wherein the catalytic particles are deposited in a monolayer.

10. The method of claim 8, wherein the metal is selected from the group consisting of Fe, Co, Ni, Y, Mo and their alloys.

11. The method of claim 10, wherein the nanosized catalytic particles are applied by an application method selected from the group consisting of transmission electron microscopy, monolayer generator 1 method, Langmuir-Blodgett, apparatus producing Langmuir-Blodgett films and Dynamic Thin Laminar Flow.

12. The method of claim 11, wherein the application method is the monolayer generator 1 method.

13. A method of producing organized nanotubes comprising:

preparing a nanotube growing mat comprising:

a substrate comprising a uniform supporting layer and carbon; and

nanosized catalytic particles in a bi-dimensionally organized monolayer on the substrate, wherein the catalytic particles are applied in a predetermined pattern on the uniform supporting layer, the pattern

promoting growth of nanotubes in an organized manner which is a function of the pattern;

activating the mat; and

flowing a carrier gas in a direction whereby the nanotubes are produced from the mat on a continuous basis.

14. The method of claim 13, wherein the substrate is porous.

15. The method of claim 12, wherein the uniform supporting layer comprises a patterned monolayer of carbon nano- or micro-particles.

16. The method of claim 15, wherein the substrate comprises non-carbon elements selected from the group consisting of Si, N, and P, to produce a hetero-substrate.

17. The method of claim 16, wherein substrate and the hetero-substrate are placed in a multilayer configuration.

18. The method of claim 16, wherein the hetero-substrate contains Si which is incorporated into the nanotube produced on the mat and produces a hetero-nanotube with carbon and silicon.

19. The method of claim 17, wherein the multilayer configuration produces a complex nanotube comprising carbon and silicon in alternating layers.

20. The method of claim 13, wherein the carrier gas comprises a carbon source, a hydrogen source and an inert gas.

21. The method of claim 20, wherein the inert gas is selected from the group consisting of He, Ne, Ar, Kr, and Xe.

22. The method of claim 21, wherein the inert gas is Ar.

23. The method of claim 13, wherein in the nanotubes are gathered and drawn away from the mat by an anchorage device or a negative pressure.

24. The method of claim 23, wherein the nanotubes are gathered by a negative pressure.

25. The method of claim 13, wherein activating the mat is achieved by applying an electric current across the mat.

26. The method of claim 13, wherein the catalytic particles are a metal.

27. The method of claim 26, wherein the metal is selected from the group consisting of Fe, Co, Ni, Y, Mo and their alloys.

28. A nanotube growing mat comprising:

a substrate comprising a uniform supporting layer and carbon;

nanosized catalytic particles, wherein a set is applied in a bi-dimensionally organized monolayer on the substrate in a predetermined pattern which

promotes growth of nanotubes from the catalytic particles as a function of the pattern.

29. The mat of claim 28, comprising an electrical connection.

30. The mat of claim 28, wherein the substrate is porous.

31. The mat according to claim 28, wherein the uniform supporting layer comprises a patterned monolayer of carbon nano- or micro-particles.

32. The mat of claim 31, wherein the carbon substrate comprises non-carbon elements selected from the group consisting of Si, N, and P, to produce a hetero-substrate.

33. The mat of claim 32, wherein carbon substrate and the hetero-substrate are placed in a multilayer configuration.

34. The mat of claim 33, wherein the hetero-substrate contains Si which is incorporated into the nanotube produced on the mat and produces a hetero-nanotube with carbon and silicon.

35. The mat of claim 33, wherein the multilayer configuration produces a complex nanotube comprising carbon and silicon in alternating layers.

36. The mat of claim 28, wherein the nanotubes are gathered and drawn away from the mat by an anchorage device or a negative pressure.

37. The mat of claim 36, wherein the nanotubes are gathered by a negative pressure.

38. The mat according to claim 28, wherein the catalytic particles are a metal.

39. The mat according to claim 38, wherein the metal is selected from the group consisting of Fe, Co, Ni, Y, Mo and their alloys.

40. The mat according to claim 28, wherein the nanosized catalytic particles are deposited on the carbon substrate by a method selected from the group consisting of transmission electron microscopy, monolayer generator 1 method, Langmuir-Blodgett, apparatus producing Langmuir-Blodgett films and Dynamic Thin Laminar Flow.

41. The mat according to claim 40, wherein the method is the monolayer generator 1 method.